Controls on extent of melting at convergent margins

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Melting at convergent margins is influenced by subduction parameters, such as convergence rate, slab angle, and thickness of the overlying lithosphere, by the chemical flux coming from the slab, and by the characteristics of the mantle wedge such as pre-existing enrichment or depletion and mantle temperature. Evaluation of trace element data and comparison to neighboring back-arcs constrains wedge composition. Thermal models permit quantification of the effect of subduction parameters on wedge temperature. These constraints can then be used to calculate the melting effects from water addition to the wedge[1]. Such models recover well the variation in extent of melting with crustal thickness for global arcs[2], and show that convergence rate is an important second order effect on controlling melting extent. Without decompression melting the extents of melting are too small to account quantitatively for Na and conservative elements, therefore both variations in wedge temperature and decompression are necessary. There is a complementarity between the effects on the slab and the effects on the wedge. Fast convergence leads to cool slabs and a hot wedge. In addition, slab temperature is strongly dependent on plate age, while wedge temperature is independent of plate age. Hot wedges tend not to receive slab melts, while cold wedges are more likely to receive them. This leads to a coupling between wedge melting effects and slab flux which contributes to the exceptionally large trace element variations observed at arcs.

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